ORD Activities on Contaminated Sediments

- NAS Report
- RTDF Sediment Action Team
- Risk Management Research

Technical Support Project Meeting

San Diego, May 2001

Trish Erickson

NRMRL

A Risk-Management Strategy for PCB-Contaminated Sediments

Committee on Remediation of PCB-Contaminated Sediments

Board on Environmental Studies and Toxicology

Division on Life and Earth Studies

National Research Council

National Academy Press

Washington, D.C.

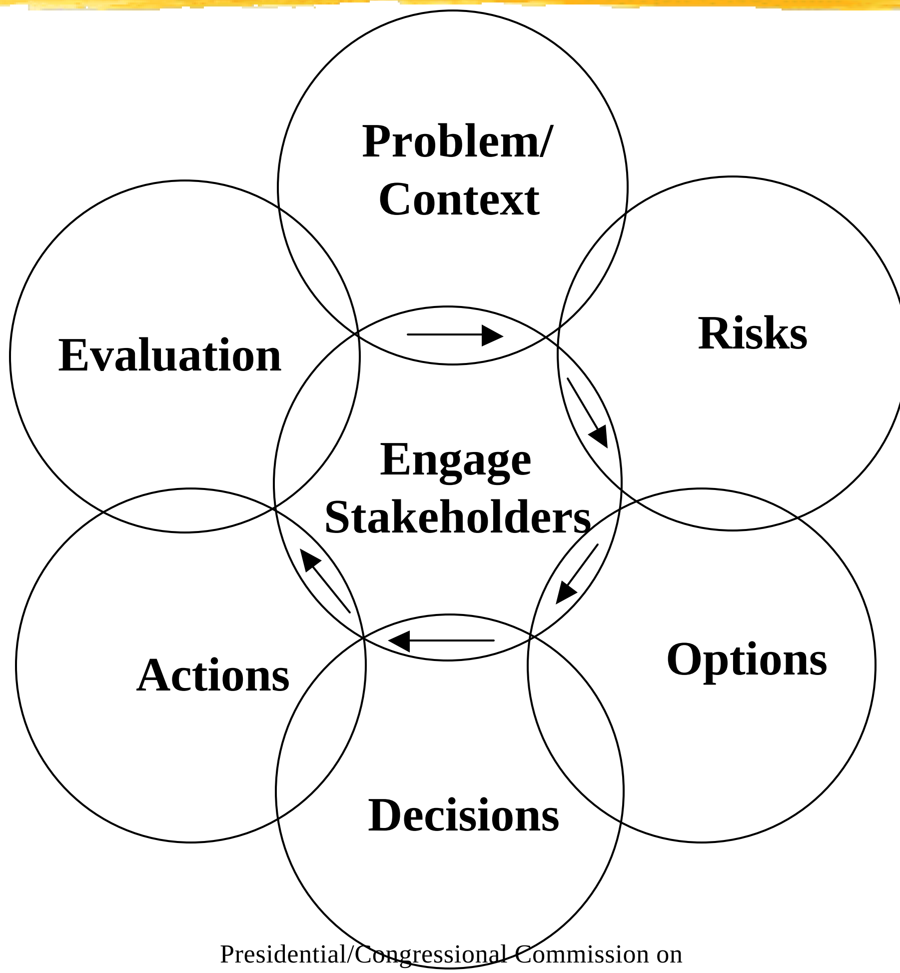
March 2001

- Requested in House FY1998 Appropriation Report
- FY1999-2001 appropriations had successively more restrictions on sediment cleanups
- Cross-office review in progress

NAS Report - Conclusions/Recommendations

- PCBs in sediments may pose long-term risks
- Need to control sources
- Make decisions on a site-specific basis
- No preferred or default remedy

- Use risk-based decision framework
- Involve affected parties as partners
- Evaluate broad range of risks for baseline and remedies, including social, economic, and cultural



Presidential/Congressional Commission on Risk Assessment and Risk Management

- Overall risk management more important than technology selection
- Consider short- and long-term risks of management options
- Conduct long-term monitoring to document performance
- Conduct further research on assessment, contaminant fate, ongoing releases, and management technologies

Remediation Technology Development Forum

Sediment Action Team

www.rtdf.org/public/sediment

RTDF Sediment Action Team

- Activities
  - Information transfer
    - January 2000 meeting on MNR
    - September 2000 meeting on in situ treatment
  - Possible demonstration projects
    - GLNPO
    - SITE

RTDF Sediment Action Team

- Membership
  - Industry
  - Consulting/research
  - Federal/state government
  - Universities

NRMRL Research on Contaminated Sediments

Remediation Research

- Two focus areas
  - Performance evaluation for existing technologies: dredging, capping, and natural recovery
  - Development/evaluation of new technologies, especially in-situ

NAS project on management of PCB-contaminated sediments completed March 2001

SAB review of MNA research due soon

Dredging

- Dredging short-term and long-term effects
  - Paper study - NCEA & NRMRL
  - Field studies to fill data gaps
- Disposal or utilization
  - SITE demos
    - Minergy Glass Furnace
    - IGT--Cement-Lock
- Confined disposal facilities
  - Bench studies of metal immobilizers

Capping

- Contaminant transport through cap
  - Modeling advective flux
  - Flux measurement in situ
- Cap placement
  - Real-time monitoring
- Cap stability - physical, chemical, biological
  - Gas evolution monitoring
- SITE demonstrations
    - Aquablok engineered cap

Monitored Natural Recovery (MNA, MNP)

- Paper evaluation of existing data sets
- Field studies
  - Lake Hartwell and Eagle Harbor
  - Additional sites
    - Vertical profiling
    - Dating/sedimentation rate
    - Fingerprinting
    - Evaluate model predictions

Other Management Methods

- Bench studies
  - bioremediation
    - delivery of amendments
  - H_2 addition
  - Zero-valent iron
  - Lead bacteria

Natural Recovery of PCB-Contaminated Sediments

Sangamo-Weston/Twelvemile Creek/Lake Hartwell Superfund Site

Victor S. Magar - Battelle

Richard Brenner - EPA

Craig Zeller - Region 4

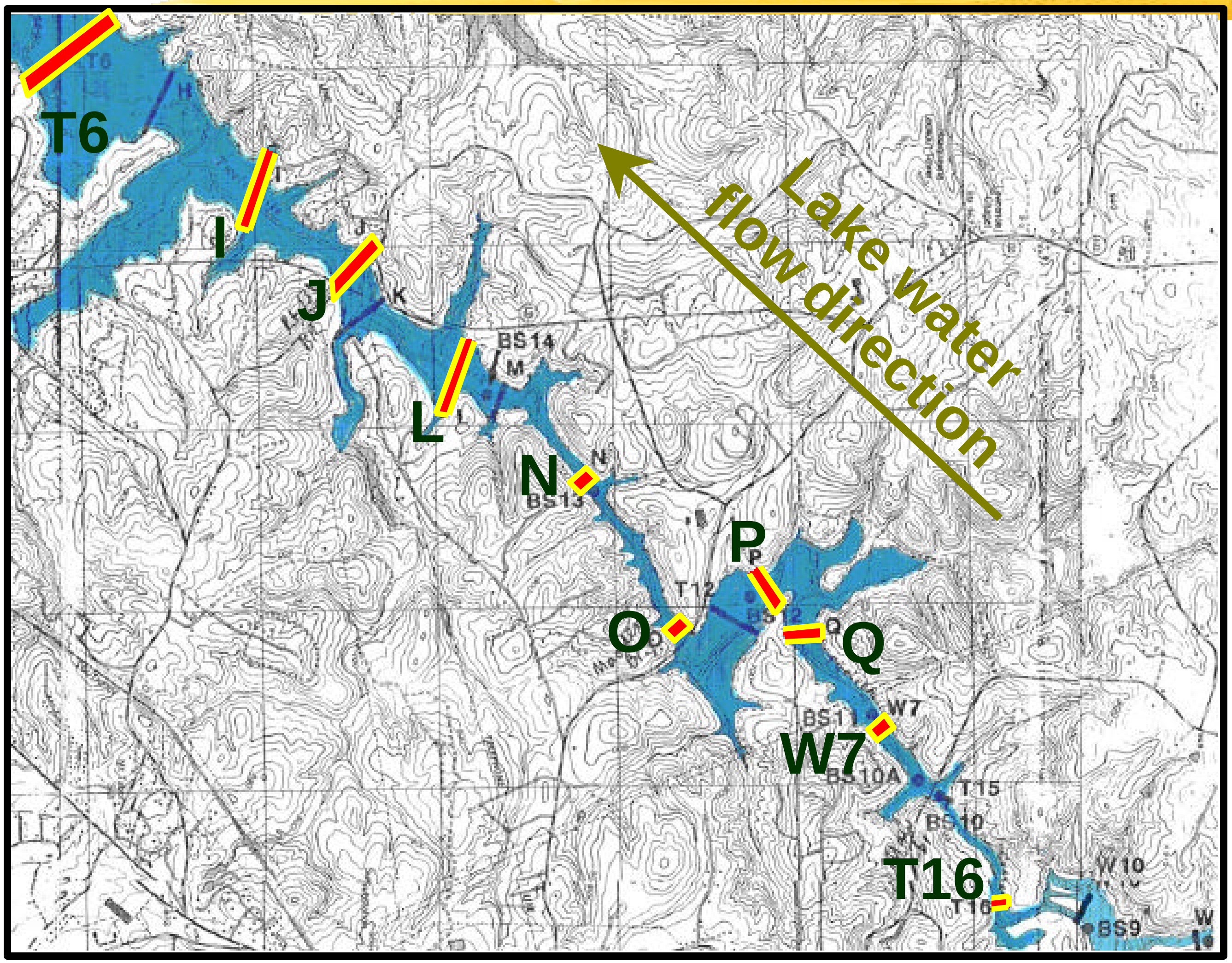
Natural Recovery Mechanisms

- Sediment containment through **natural capping**
  - Requires net depositional areas
- Contaminant **weathering**
  - Biological processes
  - Physical/chemical processes
  - Contaminant sorption/sequestration

Approach

- Collect sediment cores
  - Extrude cores into 5-cm segments
- Characterize contaminant weathering
  - Vertical PCB profiles
  - PCB fingerprinting
- Characterize sediment accumulation
  - Vertical ^{210}Pb and ^{137}Cs profiles
  - Grain size and moisture content analyses

Lake Hartwell Site Map



- Sediment cores at 10 locations
- Locations matched Reg. 4 transects
- Extruded samples after coring

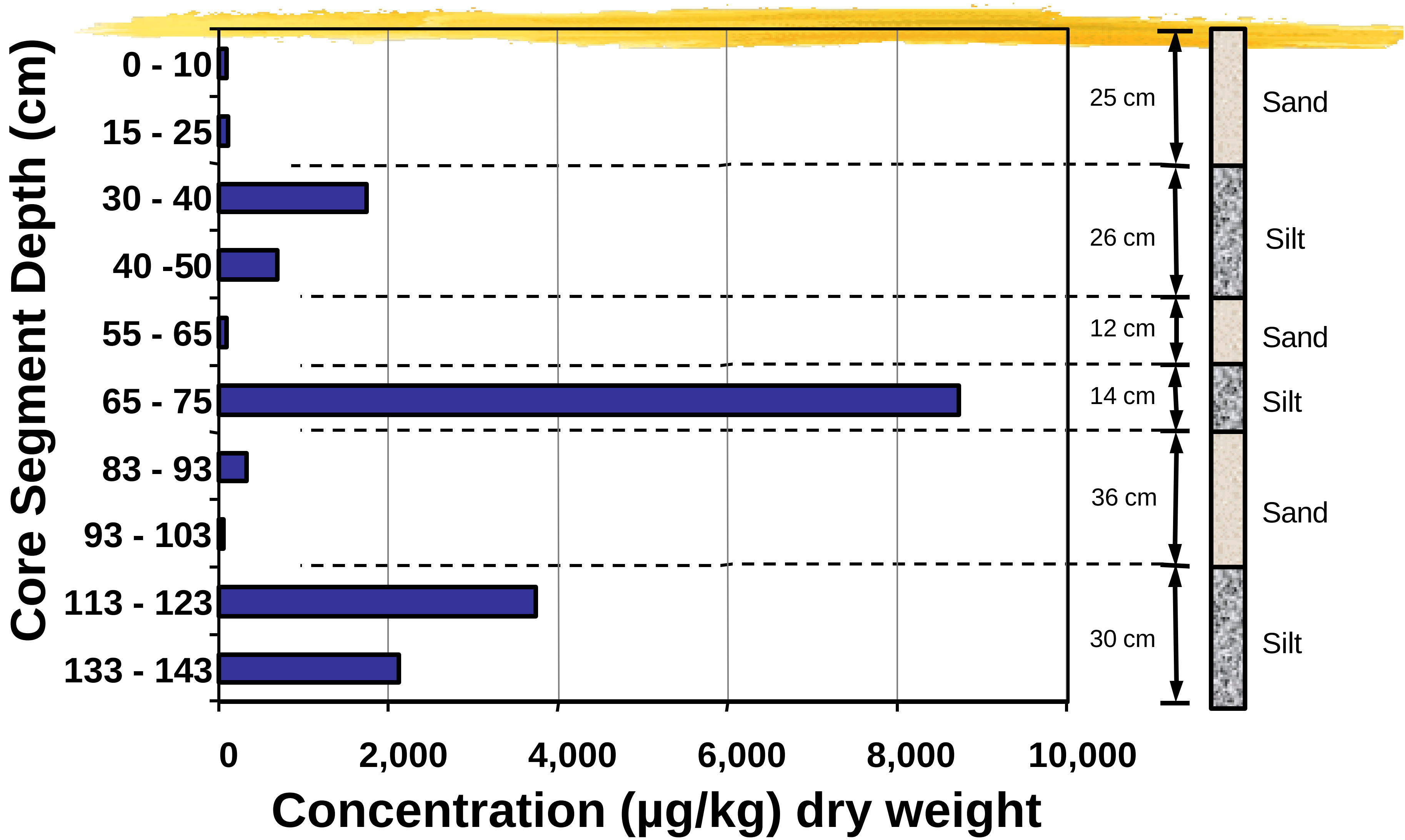
<u>Transect Locations</u>

T16, W7, Q, P, O, N, L, J, I, T6

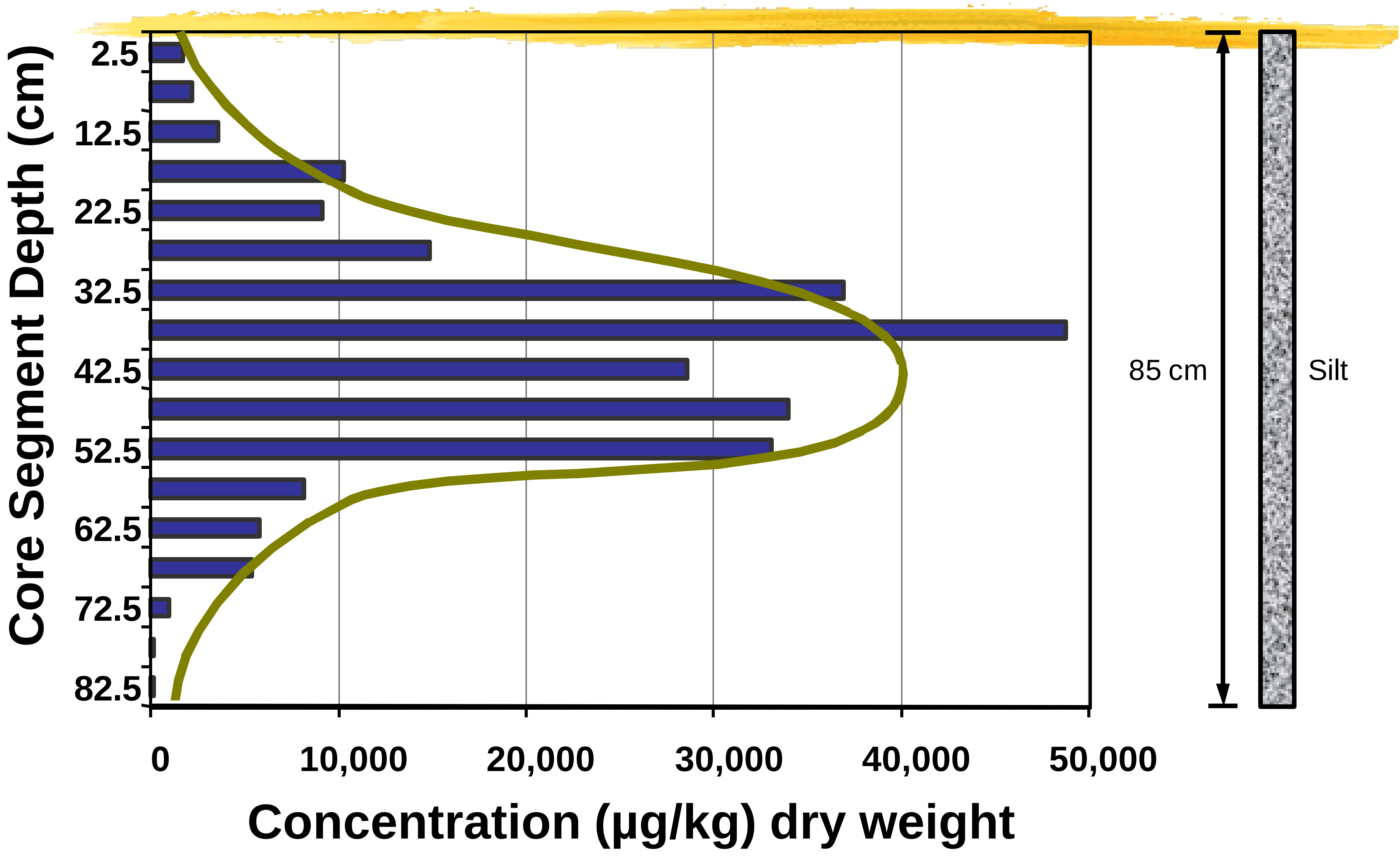
PCB Concentration Profiles (Burial)

- Upgradient cores
  - Impacted by sediment release from impoundments
  - Highest t-PCB associated with silt/clay layers
  - Surface sediments < 1 mg/kg t-PCB
- Downgradient cores
  - Not impacted by sediment release from impoundments
  - Characteristic t-PCB profiles for depositional areas
  - Decreasing surface t-PCB, approaching 1.0 mg/kg
    - Max surface t-PCB = 1.58 mg/kg (Transect L)
    - Min surface t-PCB = 0.86 mg/kg (Transect I)

Vertical t-PCB Concentration Profile
Transect Q (Upgradient)



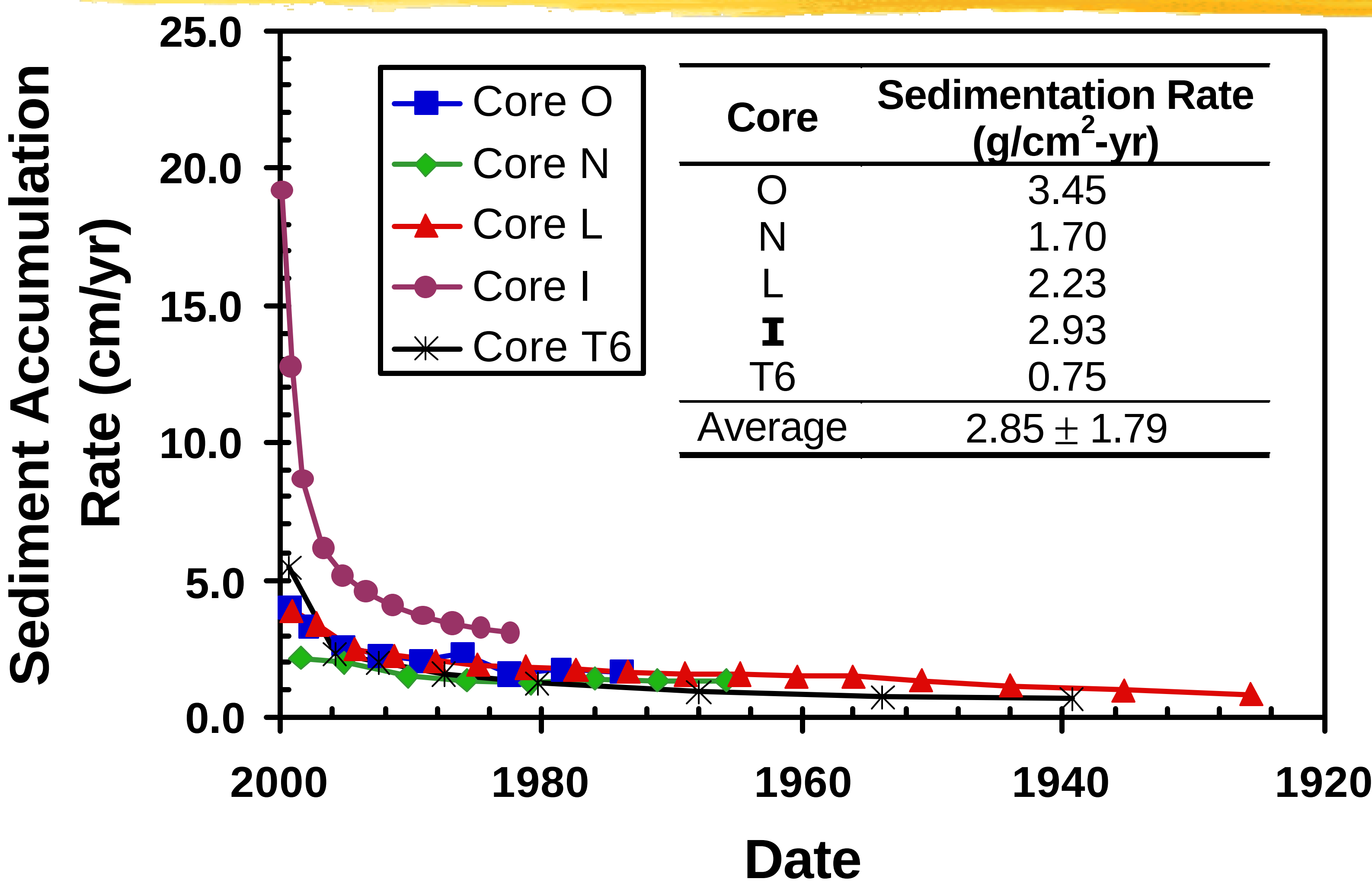
Transect L (Downgradient)



Sediment Age Dates

Core O		Core N		Core L		Core I		Core T6	
Depth (cm)	Year	Depth (cm)	Year	Depth (cm)	Year	Depth (cm)	Year	Depth (cm)	Year
2.5	1999	2.5	1998	2.5	1999	5.0	2000	2.5	1999
7.5	1998	7.5	1995	7.5	1997	12.5	1999	7.5	1996
12.5	1995	12.5	1990	12.5	1994	17.5	1998	12.5	1992
17.5	1992	17.5	1986	17.5	1991	22.5	1997	**17.5**	**1987**
22.5	1989	22.5	1981	22.5	1988	27.5	1995	22.5	1980
27.5	1986	32.5	1976	27.5	1985	32.5	1993	27.5	1968
32.5	1982	**37.5**	**1971**	**32.5**	**1981**	37.5	1991	32.5	1954
37.5	**1978**	**42.5**	**1966**	**37.5**	**1977**	42.5	1989	37.5	1939
42.5	1974			**42.5**	**1973**	47.5	1987		
				47.5	**1969**	**52.5**	**1984**		
				52.5	**1965**	**57.5**	**1982**		
				57.5	1960				
				62.5	1956				
				67.5	1951				
				72.5	1944				
				77.5	1935				
				82.5	1926				

Sediment Accumulation Rates



Core	Sedimentation Rate (g/cm^2-yr)
O	3.45
N	1.70
L	2.23
I	2.93
T6	0.75
Average	2.85 ± 1.79

Estimated Time (yrs) to Achieve Sediment Cleanup Goals

Core	1 mg/kg t-PCB	0.4 mg/kg t-PCB	0.05 mg/kg t-PCB
O	1 - 3	8 - 10	> 28
N	—	5 - 10	25 - 30
L	3 - 5	5 - 7	15 - 20
I	—	2 - 5	10 - 15
T6	—	2 - 5	10 - 15
Range	1 - 5	2 - 10	10 - 30

- **1 mg/kg:** ROD surface sediment cleanup goal (EPA, 1994)
- **0.4 mg/kg:** Mean site-specific sediment quality criteria (EPA, 1994)
- **0.05 mg/kg:** NOAEL effects range-low (EPA, 1994)

10-Year Sediment Accumulation

Transect (Core Location)	Sediment Accumulation (cm)		Comments
	HEC-6 Predicted	Measured	
T16	100-150	—	70-110 cm cap
W7	100-150	—	90 cm cap
Q	100-150	—	25 cm cap
P	50-100	—	80 cm cap
O	50-100	20-25	HEC-6 overestimated
N	50-100	12-17	HEC-6 overestimated
L	10-50	15-25	HEC-6 accurately estimated
J	≤ 10	—	Core could not be dated
I	≤ 10	32-43	HEC-6 underestimated
T6	≤ 10	12-22	HEC-6 underestimated

PCB Congener Shifts (Weathering)

- Homologue shifts to lower chlorinated congeners
  - Cl4/Cl5/Cl6 congeners reduced with depth and time (from 80% to 20% t-PCB)
  - Cl1/Cl2/Cl3 congeners increased with depth and time (from 20% to 80% t-PCB)
- Significant accumulation of ortho chlorinated congeners

Future Work

- Study cross-transects at two lake locations
- Evaluate volatilization
- Compare data to EPA's revised and updated HEC-6 model; additional modeling
- Investigate risks to benthic and aquatic organisms